*भारतीय मानक*
***Indian Standard***

**IS 2370 : 2014**
**(Reaffirmed 2019)**

# वाक-इन कोल्ड रूम — विशिष्टि

*( पहला पुनरीक्षण )*

# Walk-in Cold Rooms — Specification

*( First Revision )*

ICS 97.130.20

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Refrigeration and Air Conditioning Sectional Committee, MED 03

## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Refrigeration and Air Conditioning Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1963. The refrigeration and air conditioning industry, both in India and abroad, has made tremendous strides since then. Walk-in type cold rooms have undergone a quantum improvement with the introduction of rooms assembled with pre-fabricated rigid polyurethane foam insulated panels, installed with factory made cooling systems. These are now manufactured within the country. Hence it was decided to revise this standard for walk-in cold rooms.

The Committee responsible for the formulation of this standard has taken into consideration the views of manufacturers, consumers and technologists and has related the standard to the current manufacturing trade practices followed in the country and abroad in this field. Due weightage has also been given to the need for international co-ordination among standards prevailing in different countries of the world. Assistance has been derived from the following standards:

| | |
|---|---|
| B.S. 2502 : 1979 | Specification for manufacture of sectional cold rooms (walk-in type), issued by the British Standards Institution |
| ARI Standard 420 - 2000 | Unit Coolers for Refrigeration, issued by Air-conditioning & Refrigeration Institute, USA |
| ASHRAE Standard 25-2001 | Methods of testing forced convection and natural convection air coolers for refrigeration. |

This standard is intended chiefly to cover the technical provisions relating to walk-in cold rooms, and it does not include all necessary provisions of a contract.

The major changes in this revision are:

a) Internal cabinet and maximum ambient shade temperature have been modified.
b) The term unit cooler has been incorporated.
c) Type of refrigerants used have been modified.
d) Capacity rating test and standard rating conditions have been modified.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard

# *Indian Standard*
# WALK-IN COLD ROOMS — SPECIFICATION
## *( First Revision )*

## 1 SCOPE

**1.1** This standard covers the general constructional and performance requirements of walk-in cold rooms within the range of 5 kilolitre to 200 kilolitre gross volume capacity and operated by an electrically driven refrigerating machine of the vapor compression type. The methods of carrying out tests on walk-in cold rooms are also specified.

**1.2** The limits of internal and ambient temperature covered by the standard are:

a) Internal cabinet temperature : – 40°C to +15°C
b) Maximum ambient shade temperature : + 46°C

## 2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| *IS No.* | *Title* |
|---|---|
| 302 (Part 1) : 2008 | Safety of household and similar electrical appliances: Part 1 General requirements |
| 325 : 1996 | Three-phase induction motors |
| 661 : 2000 | Thermal insulation of cold storage — Code of practice |
| 996 : 2009 | Single-phase small ac and universal electric motors |
| 1068 : 1993 | Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium |
| 1401 : 1970 | Accessibility test probes |
| 9968 (Part 1) : 1988 | Elastomer insulated cables: Part 1 For working voltages up to and including 1 100 V |
| 12360 : 1988 | Voltage bands for electrical installations including preferred voltages and frequency |

## 3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

**3.1 Walk-in Cold Room** — A complete self-contained unit, into which a person can enter and reach any part inside, comprising,

a) the insulated cold room, made in transportable sections;
b) the unit cooler; and
c) all auxiliaries, such as fans, lights, etc, the complete unit being capable of removal from one site and re-erection on another without interference with the main structure of a building.

**3.2 Insulation (Thermal)** — A material of low thermal conductivity employed for the purpose of resisting heat flow.

**3.3 Transmittance (Thermal)** — The quantity of heat flowing per unit time through unit area of wall or partition, divided by temperature difference between the air or other fluid on either face.

**3.4 Unit Cooler** — Factory-made assembly, including means for forced air circulation and elements by which heat is transferred from air to refrigerant without any element external to the cooler imposing air resistance.

**3.4.1** *Unitary Unit Cooler* — It comprises the condensing unit, the evaporator and fans for forced air circulation, valves and piping in a single cabinet.

**3.4.2** *Split Unit Cooler* — It comprises the condensing and evaporating units in separate cabinets.

**3.5 Vapour Compression Cycle** — A refrigeration cycle in which a refrigerant absorbs heat by evaporation and after being mechanically compressed, surrenders heat during liquefaction at higher temperature level.

**3.6 Refrigerant** — The volatile fluid used in vapour compression cycle.

**3.7 High Pressure Side** — The part of refrigerating system subject to higher or condenser pressure.

**3.8 Low Pressure Side** — The part of refrigerating system subject to the lower or evaporator side.

**3.9 Evaporator** — The part of refrigerating system, which performs the function of absorbing heat.

**3.10 Condensing Unit** — The part of refrigerating system, which is responsible for condensing the low pressure evaporated vapour to high pressure liquid refrigerant. It mainly comprises a power-driven compressor; a condenser and receiver, if any.

**3.11 Unit Coolers** — A factory made assembly, including means for forced air circulation and elements by which heat is transferred from air to refrigerant without any element external to the cooler imposing air resistance. Unit cooler shall be unitary or split. The split unit cooler may be air-cooled or water cooled type.

**3.11.1** *Unitary Refrigerant Unit* — A unitary refrigerant unit consists of both evaporating unit and condensing unit in a single fabricated unit. These units may be window mounted or roof mounted.

**3.11.2** *Split Refrigerant Unit* — In split refrigerant unit the evaporating unit and condensing units are two separate units, which are connected together by refrigeration piping

**3.12 Net Total Cooling Effect** — The refrigeration capacity available for space and product cooling expressed, in W.

**3.13 Total Cooling Effect** — The heat absorbed by the refrigerant. This is the sum of the net total cooling effect and the heat equivalent of the energy required to operate the cooler.

**3.14 Temperature Difference (TD)** — The difference between the dry-bulb temperature of the air entering the unit cooler and the saturation temperature corresponding to the refrigerant pressure at the suction connection of the unit cooler.

## 4 COLD ROOM

### 4.1 Inside Dimensions

#### 4.1.1 *Inside Depth* (*Length*)

The inside depth (length) shall be mean horizontal distance between the inside surfaces of the front and back inner walls of the lining.

#### 4.1.2 *Inside Width*

The inside width shall be the mean horizontal distance between the inner surfaces of the walls on the left and right hand side.

#### 4.1.3 *Inside Height*

The inside height shall be the mean vertical distance between inside surface of the floor and ceiling of the lining.

#### 4.1.4 *Gross Volume*

Gross volume shall be the product of inside depth (length), inside width and inside height. It shall be expressed to the nearest 50 litre up to 10 kilolitre and nearest 100 litres for sizes beyond 10 kilolitre.

### 4.2 Materials

**4.2.1** Materials used in the construction of the cold room shall comply with Indian Standards where applicable, except where such requirements are otherwise modified by this standard. They shall be free from defects, which are liable to cause undue deterioration or failure.

**4.2.2** Under normal conditions of use, the materials used shall not shrink, warp or cause mould or odours, and shall be resistant to attack by vermin and destructive pests; where liable to be exposed to moisture, food products, they shall be suitably resistant and shall not contaminate stored products placed in contact with them. However, the client may like to take care of pest for example rodents, termites, bats, etc, and use suitable pest controlled method as per the site conditions. Ceiling materials (under its life span) used shall not loss any of their essential properties such as adhesion, plasticity and moisture resistance.

**4.2.3** Interior and exterior finishes shall be durable and capable of being cleaned effectively and hygienically without undue deterioration. All metal parts used inside the cold room or on the outside, where they are liable to be exposed to moisture shall be corrosion resistant or adequately protected against corrosion. Finishes shall not crack, chip, flake, rub of or soften under conditions of normal service and cleaning.

**4.2.4** Electroplated metal parts used in construction of sectional cold rooms shall conform to Grade B of IS 1068. For parts used internally, the standard shall be that for severe outdoor conditions or extra hard wear.

**4.2.5** Cadmium plating shall not be used on any part of the storage space or its fittings.

**4.2.6** Where vitreous enamelled parts are fitted, suitable means shall be provided to prevent chafing or mechanical stress likely to cause chipping. Where liable to contact with food products or their derivatives or other chemically active substances, the enamel shall be suitably resistant.

### 4.3 Construction

**4.3.1** The cold room and its parts shall be constructed with strength and rigidity adequate to normal conditions of handling, transport and usage.

**4.3.2** All joints between sections shall be so formed as to become rigid and air tight after erection, and yet allow of the sections being dismantled and properly re-erected, if required.

**4.3.3** Doors of the cold room shall be arranged for access from both inside and outside. Where so desired, an electrical alarm signal may be provided in a convenient position.

**4.3.3.1** *Door heaters*

The doors in walk-in cold room shall be equipped with suitable concealed heater wire circuit inside the door frame prevents condensation and frost formation at the edge of door and frame. The door heater of appropriate rating particularly for freezer application (below 0°C) is to be provided to prevent ice formation between door frame and the door.

**4.3.4** The type and quality of gaskets and hardware used on access doors, hatches, plugs, etc, shall be such that efficient insulation is reasonably maintained.

**4.3.5** Suitable provision shall be made to ensure that all external surfaces of the cabinet shall be reasonably free from condensation under normal conditions of service.

**4.3.6** *Internal Linings and External Fittings*

Linings and facings shall have sufficient mechanical strength to resist distortion and give reasonable protection to the insulation.

**4.3.7** *Ingress of Air*

When the doors of the refrigerated space are closed there shall be no appreciable leakage of ambient air into the interior, either past the door gasket or by any other means.

**4.3.8** *Hardware*

Door fasteners and hinges shall be smooth and positive in action and designed to maintain their proper functioning without undue wear under normal conditions of service.

**4.3.9** *Drains*

Where drains are fitted they shall have ample capacity to cope with the requirements of normal service and shall be suitably sealed against ingress of air; they shall also be accessible for cleaning.

**4.3.9.1** *Tray heater*

Evaporator drain tray shall be provided with suitable heater of appropriate rating to prevent ice formation over the tray and ensure proper flow of water to drain.

**4.3.10** *Interior Fittings*

Hanging rails and shelves shall be of robust construction, rust-proof and shall be adequately supported.

**4.3.11** *Minimum Internal Height*

The minimum height of cold room shall be 2 m.

**4.3.12** *Minimum Door Opening Sizes*

Unless otherwise specified the minimum clear opening size of door ways, shall be 1.8 m high × 0.75 m wide.

### 4.4 Thermal Insulation

**4.4.1** The quality, thickness and application of the insulating materials shall be such that efficient insulation of cold room is reasonably maintained. The whole of the external surface shall be sealed against moisture penetration by diffusion. Where the insulation space is vented to the inside, steps shall be taken to ensure that particles of the insulating material cannot escape into the storage compartment. Insulation materials confirming to IS 661 may be used.

**4.4.2** Where the moisture barrier is broken by door locks, pipes, hinges, etc, the points of entry shall be suitably sealed. Detachable plates and covers on the external surfaces shall also be provided with suitable seals against ingress of moisture into the insulation.

**4.4.3** Where the external/internal surfaces are of high heat conducting materials, they shall be separated by insulating breaker strips or their equivalent, to ensure that all external surfaces shall be reasonably free from condensation under normal conditions of service.

**4.4.4** Frame members within the insulation shall be kept to a minimum consistent with adequate constructional rigidity and loading applied in use. Where possible frame members shall not penetrate the full thickness of the insulation.

## 5 UNIT COOLER

### 5.1 Construction

**5.1.1** Pipes and connections to moving or resiliently-mounted parts shall be so arranged as not to foul or to transmit vibration to other parts. All other pipes and connections shall be secured and sufficiently free length shall be provided to minimize the risk of failure due to fatigue.

**5.1.2** Where necessary under normal operating conditions, pipes and valves shall be thermally insulated.

### 5.2 Noise

The refrigerating system shall be free from undue noise or vibration. However the noise level shall not be exceeding 85 db.

**5.2.1** *Noise Level*

The noise level of unit cooler, unitary unit cooler, split unit cooler shall not exceed 85db noise level while measuring at 1.5 m radius away from each unit.

### 5.3 Water Condensation

Suitable means shall be provided to prevent water condensed on cold parts of the refrigerating system from effecting the operation of the unit or its controls. Suitable means shall be provided to prevent moisture dripping or splashing from baffles, drip trays or other cold parts on to the food or other products placed in the cold room.

### 5.4 Safety Features in Design (Operation of Safety Device)

Refrigerating piping, valves, fittings, their related parts and all material used in the construction and installation of refrigerating system shall be suitable for the refrigerant used. No material which would deteriorate due to chemical action of the refrigerant or the oil or the combination of both and moisture shall be used. Aluminum, zinc or magnesium shall not be used in contact with methyl chloride. Magnesium alloys shall not be used in contact with chloro-fluoro derivatives of methane and ethane. Copper and copper alloys shall not be used in contact with ammonia.

**5.4.1** All joints shall be readily accessible.

**5.4.2** Joints from refrigerant copper pipe and fittings made with solder or other alloys shall have melting point of,

a) not less than 260°C for pipe sizes up to 32 mm; and
b) 540°C for pipe sizes above 32 mm and for all the sizes on hot gas lines.

**5.4.3** Stop valves shall be installed on all systems other than those using centrifugal compressors, containing more than 10 kg of refrigerant. The location of the stop valves shall be as given in **5.4.4**.

**5.4.4** Stop valve shall be provided at the inlet and outlet ends of each of compressor, receiver and evaporator.

**5.4.5** When the door or hatch is left open under normal operating conditions, the automatic overload protective device shall come into operation.

### 5.5 Control of Operation

Refrigerant flow and compressor driving motor operation shall be automatically controlled to reduce the cabinet temperature to the temperature specified and to maintain it within the limits of the application.

### 5.6 Location of Components

The evaporator and any associated screens, baffles, drip tray, etc, shall not obstruct access to stored products. All control devices and service valves shall be readily accessible.

### 5.7 Defrosting System

Unit coolers which maintain room temperature below 0ºC shall be provided with a suitable defrosting system to remove excess frost on the evaporator coil, which may affect the cooling capacity. This defrosting system shall operate automatically by means of a suitable controller.

**5.7.1** *Pressure Relief System*

A pressure relief valve system of suitable capacity and number shall be provided for all the cold rooms operating below 0°C.

### 5.8 Optional Items

The manufacturer/supplier shall make available the following items at extra cost and as agreed to between the purchaser and the manufacturer.

Air curtain and air shield PVC strip curtain, Exterior ramps, door kick plates, Bumper rail, Protecting guard for sliding doors, corner protectors, partition walls and doors from same materials, roof mounted refrigeration unit, extra lighting, vision panel in doors be supplied, where necessary.

## 6 ELECTRICAL EQUIPMENT

### 6.1 Rating of Motors

All motors shall be continuously rated and shall be suitable for the particular application. Motors, other than that of hermetically sealed compressor units, shall comply with IS 325 or IS 996, as applicable. Motors of hermetically sealed compressor units shall be of adequate rating to comply with the test for adequate rating of compressor motors (*see* **6.9**). For compressor motors an external over load relay shall be provided in addition to the inherent protection provided by the compressor manufacturer.

**6.1.1** *Micro Processor Based Controller*

All walk-in cold room refrigeration system operation shall be controlled through microprocessor based controller.

### 6.2 Motor Overload Protection

Motor shall be adequately protected against dangerous over heating arising from excessive current. Small FHP single phase motors shall be provided with a fuse protection.

### 6.3 All Control Gear shall Comply with Relevant Indian Standards, Where Applicable

### 6.4 Cables and Flexible Cords

Flexible supply cords and all cables used shall comply with IS 9968 (Part 1) as regards thickness of insulation, insulation resistance, voltage test and, in the case of flexible supply cords only, colour. The current carrying capacity of each cable and flexible cord shall be adequate for its full load current. Where a flexible supply cord passes through holes in metal parts such holes shall be shaped or bushed to protect the flexible cord from damage.

### 6.5 Wiring

**6.5.1** The wiring methods, together with the design, arrangement and workmanship employed, shall give full protection to the electrical insulation against mechanical damage from oil, heat, refrigerant, moisture or corrosive materials where these could be encountered. Conduit for internal wiring shall be adequately sealed against ingress of moisture.

**6.5.2** Soldering fluxes shall not cause corrosion.

### 6.6 Accidental Contact

Live parts shall be protected by suitable guards, shields or screens of adequate strength and durability so that there is no possibility of making inadvertent contact under normal service conditions. It shall not be possible to touch live parts with the accessibility test probes following the procedure described in IS 1401 even after the removal of covers or casings which can be removed without the use of tools, or during replacement of the lamp.

### 6.7 Internal Electrical Components

Internal lamps shall be mounted in suitable fittings and provided with guards for protection against mechanical damage. Internal fans shall be suitable for operation at the lowest air temperature likely to occur.

### 6.8 Earthing

Metal casings of the electrical components, metal frame and all exposed metallic parts likely to become alive shall be provided with earthing facilities in accordance with the requirements given in IS 302 (Part 1).

### 6.9 Standard Rating Conditions for Unit Coolers for Refrigeration

The evaporators shall be designed keeping the temperature difference between the cold room (return air), temperature and the saturated section temperature of the refrigerant as 5°C. Refer Table 1 given below. Moreover, the end user shall have freedom to specify the RH percent while sending inquiry.

## 7 CLASSIFICATION OF TESTS

Tests shall be classified into three groups, namely,

a) production routine tests;
b) type tests; and
c) acceptance tests.

### 7.1 Production Routine Tests

These shall consist of routine tests that would be conducted on each and every unit after completion at the manufacturer's works.

**7.1.1** *General Running Test*

Each unit shall be given a run to ensure vibration free and satisfactory operation of mechanical parts.

**7.1.2** *Pressure Tests*

The manufacturer shall test all parts of the refrigerating system to pressures at least 1.2 to 1.5 times of the design operating condition (depends on air cooled or water cooled/evaporative type condenser used) of the refrigeration system (low side and high side of the system) but not less than those given in Table 2. The system shall be kept under pressure for a minimum period of 24 h and no reduction in pressure is acceptable, after holding 24 h

**Table 1 Standard Rating Conditions for Unit Coolers for Refrigeration**

(*Clause* 6.9)

| Sl No. | Group Number | Inlet Air Temperature | | Nominal Relative Humidity | Saturated Suction Temperature |
|---|---|---|---|---|---|
| | | Dry-Bulb °C | Wet-Bulb °C | | |
| (1) | (2) | (3) | (4) | (5) | (6) |
| i) | High | +10 | 7.2 | 70 | +5.0 |
| ii) | Medium above freezing | +2.0 | — | — | –3 |
| iii) | Medium below freezing | –18 | — | — | –23 |
| iv) | Low | –23 | — | — | –28 |
| v) | Very low | –25 | — | — | –40 |

## Table 2 Minimum Test Pressures

(*Clause* 7.1.2)

| **Sl No.** (1) | **Refrigerant** kg/cm$^2$ (2) | **Chemical Formula** kg/cm$^2$ (3) | **High Pressure Side** (4) | **Low Pressure Side** (5) |
|---|---|---|---|---|
| i) | System with air cooled condenser operation: | | | |
| | a) Ammonia R 717 | $NH_3$ | 33 | 22 |
| | b) Chlorodifluoromethane R 22 | $CHClF_2$ | 32 | 20 |
| | c) 1,1,1,2-Tetrafluoroethane R 134a | $CH_2$ FC $F_3$ | 20 | 20 |
| | d) R 404A | — | 36 | 20 |
| ii) | System with water cooled/evaporative condenser operation: | | | |
| | a) Ammonia R 717 | $NH_3$ | 22 | 22 |
| | b) Chlorodifluoromethane R22 | $CHClF_2$ | 22 | 20 |
| | c) 1,1,1,2-Tetrafluoroethane R 134a | $CH_2$ FC $F_3$ | 20 | 20 |
| | d) R 404A | — | 25 | 20 |

**7.1.2.1** *Vacuum test*

The manufacturer shall carry out vacuum test of entire system at vacuum as per altitude and hold it for minimum period of 8 h. No raise in pressure shall be noticed after holding for 8 h period.

**7.1.3** *Electrical Tests of Unit Cooler*

a) *Insulation resistance* — The insulation resistance between all electrical circuits and the earthed metal parts when measured at normal room temperature with a voltage of not less than 500 V dc shall be not less than one mega ohm; and
b) *High potential test* — The normal insulation of all electrical circuits at room temperature shall be such as to withstand a high-potential test of 2 000 V rms applied for not less than five seconds between all circuits and accessible metal parts.

For refrigerating machinery to be connected to circuits of 50 V and below the high-voltage test shall be 500 V rms. The test voltage shall be alternating, of approximately sine wave form and of any convenient frequency between 25 and 100 cycles/s.

### 7.2 Type Tests

The type tests shall consist of the tests that would be necessary to check the performance and characteristics of the units and components and shall be carried out by a recognized testing authority, who may be the manufacturer, if approved by the purchaser. Once a walk-in cold room has undergone type tests, any major or essential alterations, which the manufacturer intends to make, shall be reported to the testing authority and further type tests shall be carried out in accordance with the procedure laid down in this standard Besides all the production routine tests specified in **7.1**, the type tests comprise the following.

**7.2.1** *Cold Room*

**7.2.1.1** *Door seal test*

Visual light ingress test from ambient into the dark cold room (finished cold room without lights) shall indicate gaps in the door to frame sealing.

**7.2.1.2** *Thermal insulation*

The insulated structure of the cold room after assembly shall be tested by the heat-input method to determine its thermal transmittance. For this purpose the interior of the cold room shall be heated by an electrical heater (or heaters) suitably shielded to prevent radiation to the walls and so located as to ensure a uniform temperature of 14 ± 1°C above the ambient temperature outside the test room and maintained at that temperature for 30 h.

The record of electrical energy input and inside and outside temperatures shall be taken hourly during the last 6 h. From this record, compute the heat dissipation from the cold room to the outside ambient, from which calculate the thermal transmittance. The thermal transmittance shall not exceed the value specified.

$$\text{Thermal transmittance} = Q \times 1\,000/6\,A\,(t_o - t_i)$$

where

$Q$ = kWh recorded for 6 h;
$A$ = mean area of cold room walls and ceiling; and
$t_o, t_i$ = average outside and inside temperatures respectively.

**7.2.2** *Unit Cooler*

The tests as per **7.2.2.1**, **7.2.2.2**, **7.2.2.3** and **7.2.2.4** shall be carried out on the fully assembled unit cooler with all its panels, fittings and standard accessories (if any) in place.

**7.2.2.1** *Measurement of air-flow*

The evaporator air flow shall be measured at rated voltage and frequency with a calibrated anemometer/ any other suitable velocity probe and s given by:

$$\text{Air flow} = A \times v \text{ m}^3\text{/h.}$$

where

$A$ = area over which at least 16 anemometer readings are taken at equispaced locations, in $m^2$; and

$v$ = mean velocity of air, in m/h.

**7.2.2.2** *Capacity rating test*

a) *Method 1* — The cooling capacity may be determined by using the enthalpy change of the refrigerant across the evaporator and the refrigerant mass flow rate. Any enclosure in which the specified test conditions can be maintained within a tolerance of ±1°C may be used to determine cooling capacity.

Refrigerant side gross cooling capacity can be computed by the product of mass flow rate of refrigerant and the enthalpy difference at the inlet and outlet of the cooler.

Enthalpies at the inlet and outlet of the cooler can be read off the standard P-H chart or tables based on the refrigerant inlet and outlet conditions.

Refrigerant flow shall be measured by a refrigerant flow meter with an accuracy of 2 percent of the quantity measured.

Net cooling capacity shall be found by gross cooling capacity minus ($E_c + E$).

b) *Method 2* — This method determines the cooling capacity of a unit cooler by measuring the electrical input to a calibrated box (*see* Fig. 1) so as to maintain specified temperature and humidity conditions inside the calibrated box at a specified outside ambient temperature. The size of the calibrated box shall be such that it shall not restrict the normal flow of air around the equipment to be tested. In no case shall the heat leakage of the calibrated box exceed 30 percent of the gross total cooling effect of the air cooler under test.

For forced circulation unit coolers, Air side gross cooling capacity can be found by:

$$q_{ta} = K_c\,(t_4 - t_3) + E_c + E \text{ W}$$

where

$q_{ta}$ = air side gross cooling capacity, in W;

$K_c$ = heat leakage coefficient of calibrated box, in W/°C;

$E_c$ = total electrical input to heaters and auxiliary equipment of calibrated box, in W;

$E$ = total electrical input to fan motor(s) of unit cooler, in W;

$t_4$ = average dry-bulb temperature of air surrounding the calibrated box, in °C; and

$t_3$ = average dry-bulb temperature of air within the calibrated box, in °C.

Net cooling capacity shall be found by gross cooling capacity minus ($E_c + E$).

*Calibration of the Calibrated box* — The heater input shall be adjusted to maintain an average box temperature of 14 ± 1°C above the outside surrounding temperature. The box temperature shall be taken as the average of all readings.

A calibration test shall be the average of eleven consecutive hourly readings that fall within the limits specified by this standard.

A calibration test shall be made for the maximum and the minimum forced air movements expected in the use of the test box. The calibration heat leakage shall be plotted as a straight line function of these two air quantities and this curve shall be used as calibration for the box.

The calibration heat leakage of the calibrated box shall be computed as described in **7.2.1.2**.

**7.2.2.3** *Power consumption test*

The power consumption of the unit cooler shall be measured during the capacity rating test at the standard rating conditions given in **6.9**.

NOTE — Attention is drawn to IS 12360 where it is recommended adoption of 240 V single phase in place of 230 V single phase. In the interim period, however, 230 V single phase will be permissible voltage.

**7.2.2.4** Maximum operating condition test is conducted at an outdoor ambient temperature of 46°C and at specified indoor temperature (*see* **6.9**). The unit cooler shall operate for at least 2 h without tripping of the compressor or any of the safety controls.

### 7.3 Acceptance Tests

If the purchaser desires any of the production routine tests to be repeated at the time of purchase, where agreed to between the purchaser and the manufacturer, the tests may be carried out at the manufacturer's works. Alternatively, the tests may be repeated at the place specified by the purchaser.

### 7.4 Preparation of Units for Tests

**7.4.1** *Preparation of Selected Units*

a) The cold room and unit cooler shall be

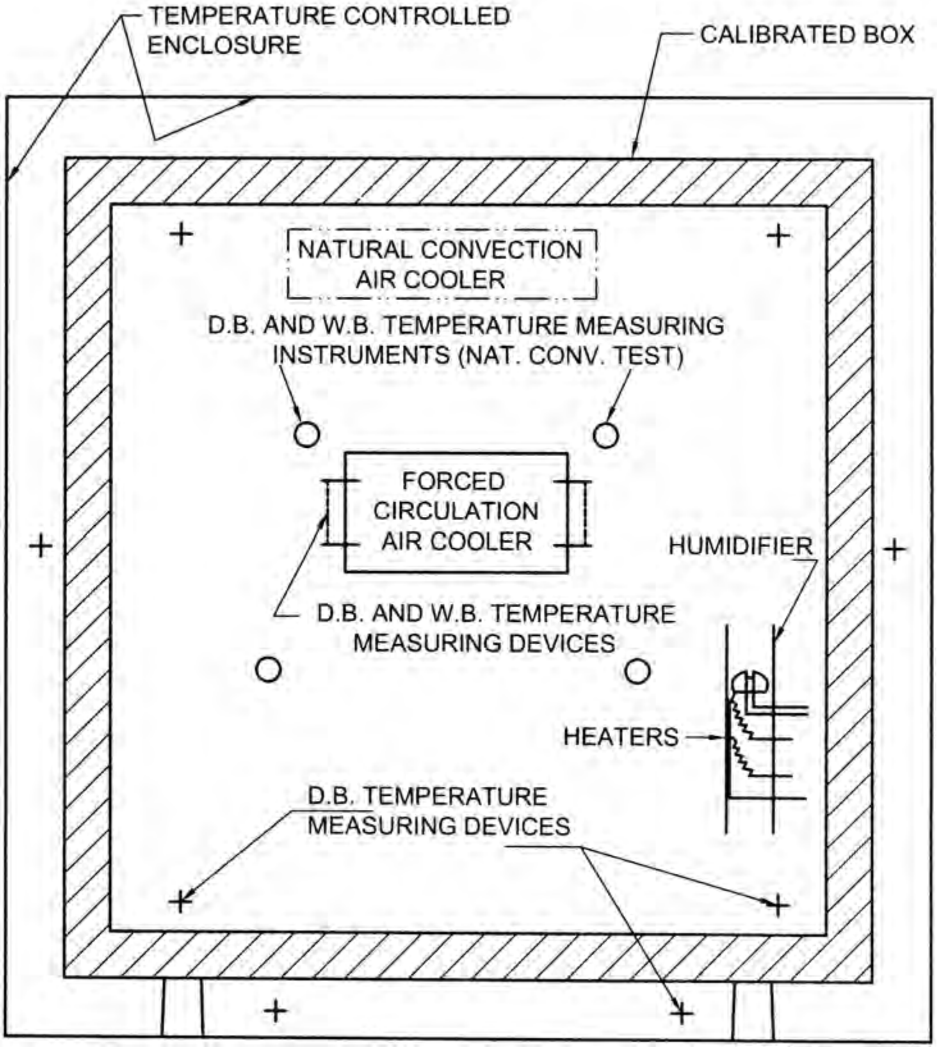
TEMPERATURE CONTROLLED ENCLOSURE
CALIBRATED BOX
NATURAL CONVECTION AIR COOLER
D.B. AND W.B. TEMPERATURE MEASURING INSTRUMENTS (NAT. CONV. TEST)
FORCED CIRCULATION AIR COOLER
HUMIDIFIER
D.B. AND W.B. TEMPERATURE MEASURING DEVICES
HEATERS
D.B. TEMPERATURE MEASURING DEVICES

FIG. 1 CALLIBRATED BOX METHOD

installed as in normal service. All permanently located accessories shall be in their proper places but the storage space shall otherwise be empty during all tests except as limited by the test conditions herein stated; and

b) Before the unit cooler is put on test, it shall be given a minimum run-in period of 12 h.

### 7.5 General Requirements for Tests

#### 7.5.1 *Test Conditions*

a) The sectional cold room shall be so placed or shielded as to prevent direct radiation from the heating equipment. Air circulation in the test room shall be such that the specified uniformity of temperature distribution is obtained without a direct draught upon the room under test. Windows in the test room shall be provided with suitable radiation shields. The cold room shall be shielded from extraneous air currents which exceed 15 m/min.

b) The interior of the cold room shall be dried immediately before the stabilization period preceding the tests.

c) The cabinet door (or doors) shall be kept closed during each test.

#### 7.5.2 *Temperatures*

##### 7.5.2.1 *Ambient temperatures*

a) Outside ambient temperature shall be maintained to within ± 1.5 ºC of the specified value, and shall be measured at points located at 1 m from the floor and 0.25 m from the sides and front of the cold room. This condition shall be maintained during both stabilizing and test periods.

b) The ambient temperature shall be recorded at one of the above positions, preferably with a recording instrument. If an indicating instrument is used, readings shall be taken at intervals of 30 min.

c) The vertical temperature gradient from the floor to a height of 2 m shall not exceed 1.5 ºC for each meter of vertical distance.

**7.5.2.2** *Internal cold room temperature*

a) Temperature of the cold room air shall be measured in at least six representative positions and the mean shall be taken as the cold room temperature;

b) All the temperature measuring elements shall be supported in the cold room in such a manner that there shall be at least 13 mm of air space separating the thermal element from contact with heat conducting surfaces in the cold room. Connections from the temperature measuring elements shall be brought to the outside of the room in such a manner as to interfere as little as possible with air seals; and

c) The inside temperature shall be maintained to within ±2°C or lower as agreed to between the parties.

**7.5.3** *Electrical Supply*

The condition specified for tests shall be average values within the following variations:

a) ±2 percent of standard voltage; and

b) ±1 percent of supply frequency.

**7.5.4** *Instruments and Measurements*

a) All instruments used for measuring shall be calibrated against a secondary standard before making each test or series of tests;

b) Temperature measuring instruments shall be accurate to 0.3ºC; and

c) The operating time of the unit shall be obtained by means of a recording meter or a self-starting synchronous electric clock.

## 8 MANUFACTURER’S GUARANTEE

The manufacturer shall give a guarantee for the soundness of construction and performance of the cold room, and shall be responsible for putting right any manufacturing defects free of charge for a period of twelve months from the date of sale to the original purchaser or date of inspection or approval in the case of government or semi-government institutions, it being understood that such repairs or replacements of defective parts to be carried out at the manufacturer’s works.

## 9 MARKING

**9.1** The sectional cold room shall have the following information marked on a nameplate in permanent and legible manner in location where it is accessible and visible:

a) Name of the manufacturer or sponsor of the complete assembled unit;

b) Voltage rating and normal running current of the unit cooler;

c) Name and the maximum weight of the refrigerant used; and

d) Type, model, catalogue and serial number of the cold room compressor, motor, etc, or sufficient information to provide adequate identification for replacement of parts or necessary servicing;

**9.2** The following information shall be provided by the manufacturer or the sponsor of each complete unit, not necessarily in a permanent marking:

a) Operation instructions;

b) Internal volume; and

c) Net storage surface.

### 9.3 BIS Certification Marking

Each walk-in cold room may also be marked with the Standard Mark.

**9.3.1** The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of Standard Mark may be granted to the manufacturers or the producers may be obtained from the Bureau of Indian Standards.

# ANNEX A

(*Foreword*)

## COMMITTEE COMPOSITION

Refrigeration and Air Conditioning Sectional Committee, MED 03

| *Organization* | *Representative*(*s*) |
|---|---|
| Indian Institute of Technology, New Delhi | Prof Sanjeev Jain (***Chairman***)<br>Shri P. M. V. Subbarao (*Alternate*) |
| ACR Project Consultants, Pune | Shri Arvind G. Surange<br>Shri M. Saravanan (*Alternate*) |
| All India Air Conditioning and Refrigeration Association, New Delhi | Shri S. K. Sharma |
| Annapurna Electronics and Services Limited, Hyderabad | Shri G. K. Prasad<br>Shri Prem Chander (*Alternate*) |
| Applicomp (India) Limited, Bangalore | Shri B. P. Harish |
| Bureau of Energy Efficiency, New Delhi | Shri S. P. Garnaik<br>Shrimati Vineeta Kanwal (*Alternate*) |
| Carrier Aircon Ltd, Gurgaon | Shri J. P. Gopal<br>Shri Ajay Pratap Singh (*Alternate*) |
| Central Power Research Institute, Bangalore | Shri A. R. Ravikumar<br>Shri Gujjala B. Balaraja (*Alternate*) |
| Consumer Education and Research Centre, Ahmedabad | Ms Sweta Mahajan |
| Directorate of Quality Assurance (Engineering Division), Pune | Shri J. P. Tiwari<br>Lt Col Mahendra Prasad (*Alternate*) |
| Directorate General of Supply and Disposals, Ahmedabad | Shri R. K. Agrawal<br>Shri Sanjeet Kumar (*Alternate*) |
| EKL Appliances Limited, Aurangabad | Shri Sethuraman<br>Shri V. Srinivasan (*Alternate*) |
| Electrical Research and Development Association, Vadodara | Dr G. S. Grewal<br>Shri C. B. Mehta (*Alternate*) |
| Electronic Regional Test Laboratory (North), New Delhi | Shri Ashok Kumar<br>Shri D. K. Gulati (*Alternate*) |
| Emerson Climate Technologies (India) Limited, Karad | Shri Chethan Tholpady<br>Shri D. P. Despande (*Alternate*) |
| Godrej Appliances Limited, Mumbai | Shri B. J. Wadia<br>Shri A. Acharekar (*Alternate*) |
| Indian Institute of Chemical Engineering, Kolkata | Dr D. Sathiyamoorthy<br>Dr Sudip K. Das (*Alternate*) |
| Intertek Testing Services (I) Private Limited, New Delhi | Shri Manmohan Kulashri<br>Shri Puneet Randeo (*Alternate*) |
| Krishak Bharati Co-operative Limited, Surat | Shri K. Srihari<br>Shri Jatinder Sondhi (*Alternate*) |
| Lawkim Limited, Satara | Shri Kishor M. Joshi<br>Shri Rasik P. Khavnekar (*Alternate*) |
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| National Horticulture Board, Gurgaon | Dr R. K. Sharma<br>Shri Brajendra Singh (*Alternate*) |
| National Thermal Power Corporation, Noida | Shri D. K. Suryanarayan<br>Shri S. K. Jha (*Alternate*) |
| Nirma University of Science and technology, Ahmedabad | Dr Vikash J Lakhera |
| Refrigeration and Airconditioning Manufacturer Association, New Delhi | Shri A. K. JOSHI<br>Shri R. K. Mehta (*Alternate*) |

| *Organization* | *Representative(s)* |
|---|---|
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| Voltas Limited, Mumbai | Shri Deepak Baid<br>Shri A. D. Kumbhar (*Alternate*) |
| Voluntary Organization in Interest of Consumer Education, New Delhi | Shri T. C. Kapoor<br>Shri I. H. Wadhwa (*Alternate*) |
| Western Refrigeration Private Limited, Mumbai | Shri Paresh Patil<br>Shri Harmeet Singh (*Alternate*) |
| Whirlpool of India Limited, Distt Pune | Shri V. Sugosh<br>Shri Satish Shiggaon (*Alternate*) |
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Shri M. K. Paramanik
Scientist 'C' (med), BIS

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